University of California

Nitrogen Management Training

for Certified Crop Advisers

Nitrogen Management in Nuts: Walnut, Almond, and Pistachio

UC Cooperative Extension | University of California Agriculture and Natural Resources

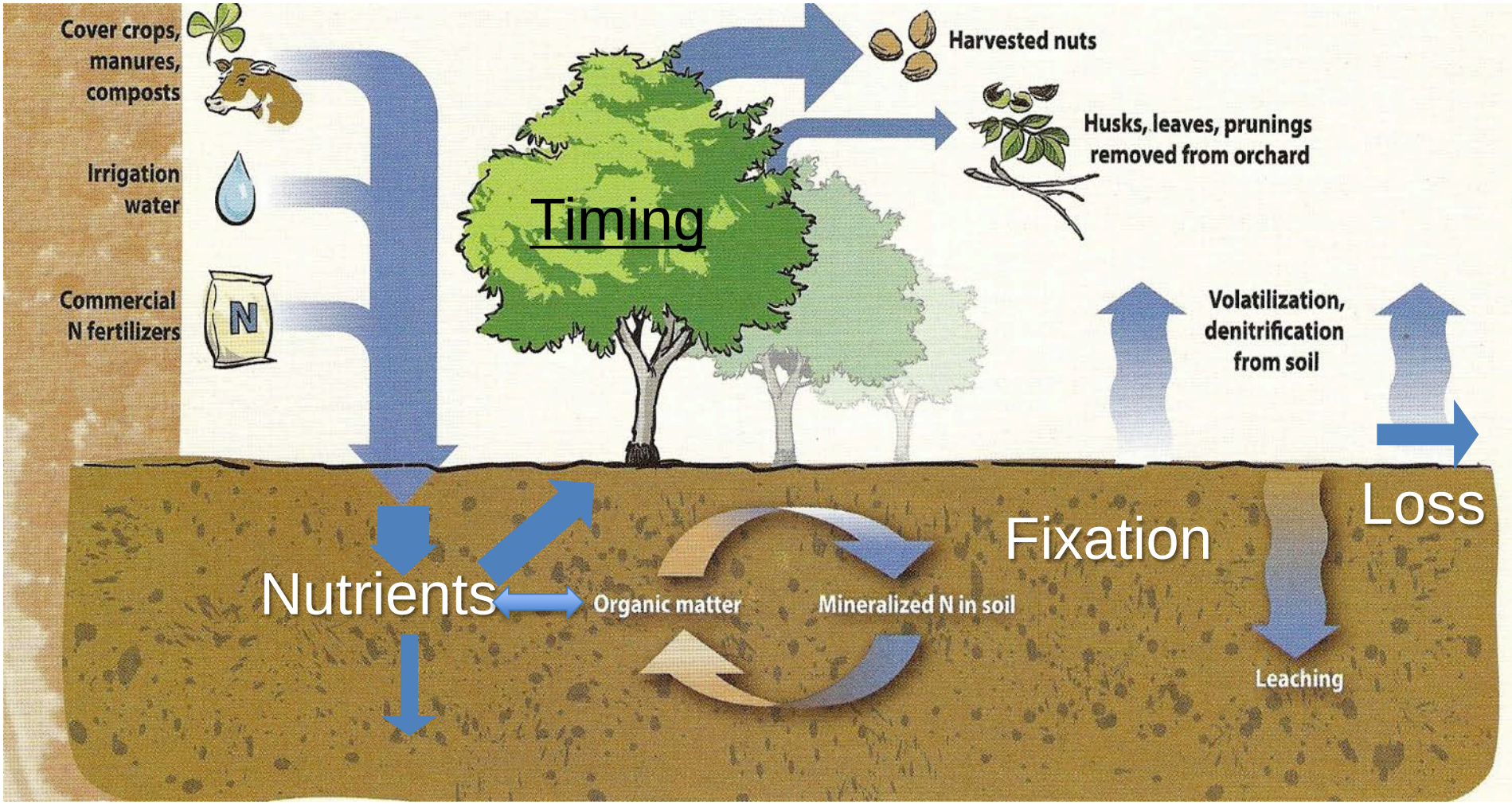
Efficient Nitrogen Management
-the 4 R's-

- Apply the Right Rate
  - Match supply with tree demand (all inputs- fertilizer, organic N, water, soil).
- Apply at the Right Time
  - Apply coincident with tree demand and root uptake.
- Apply in the Right Place
  - Ensure delivery to the active roots.
  - Minimize movement below root zone
- Using the Right Source and Monitoring
  - Maximize uptake, maximize response and minimize loss.

The 4 R's are specific to every orchard each year.

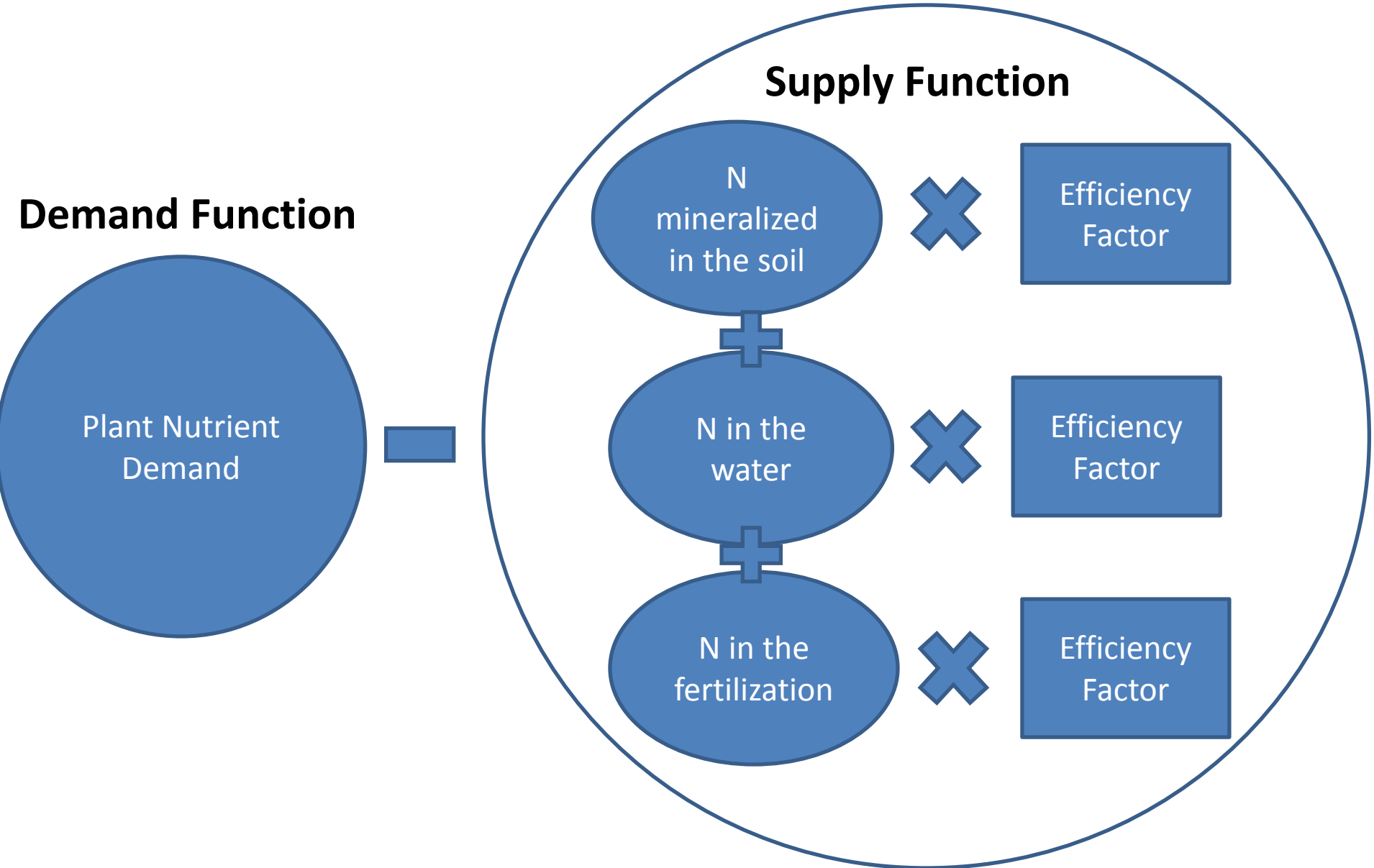
Optimizing N Use in Tree Crops

Supply (Rate) = Demand (Amount and Timing)



Kathy Kelley-Anderson et al: ANR Pub # 21623

The Right Rate Equation



N Demand Rates

Right Rate: Almonds

Nutrient removal Per 1000 lb Kernels

Nonpareil

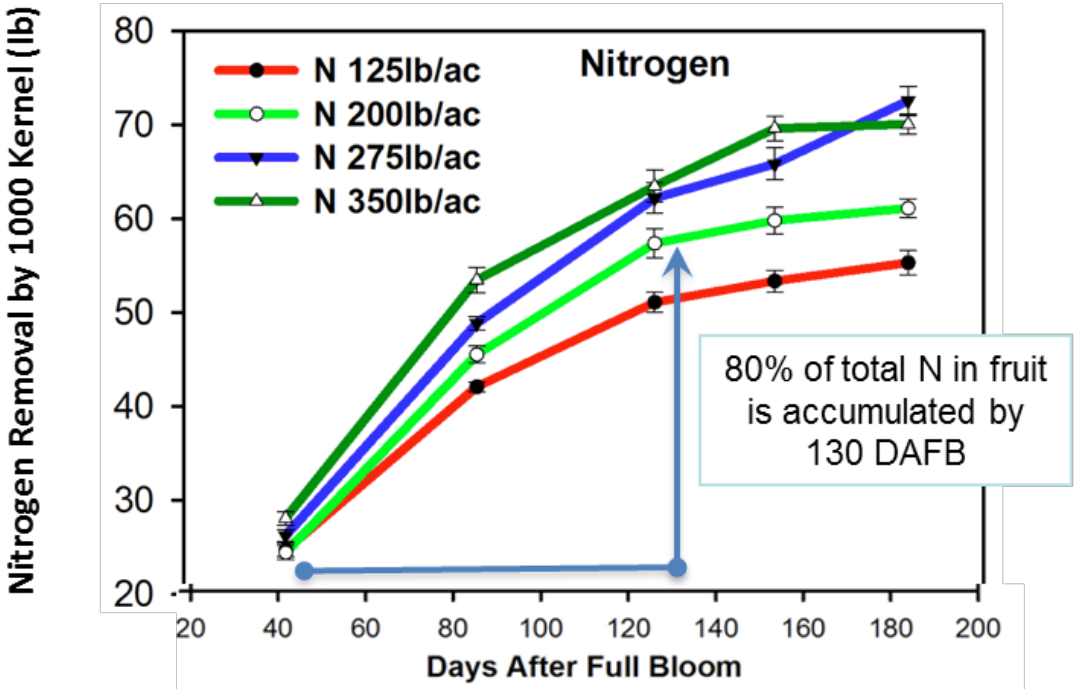
- N removal 68 lb per 1000 lb Kernels

Monterey

- N removal 65 lb per 1000 lb Kernels

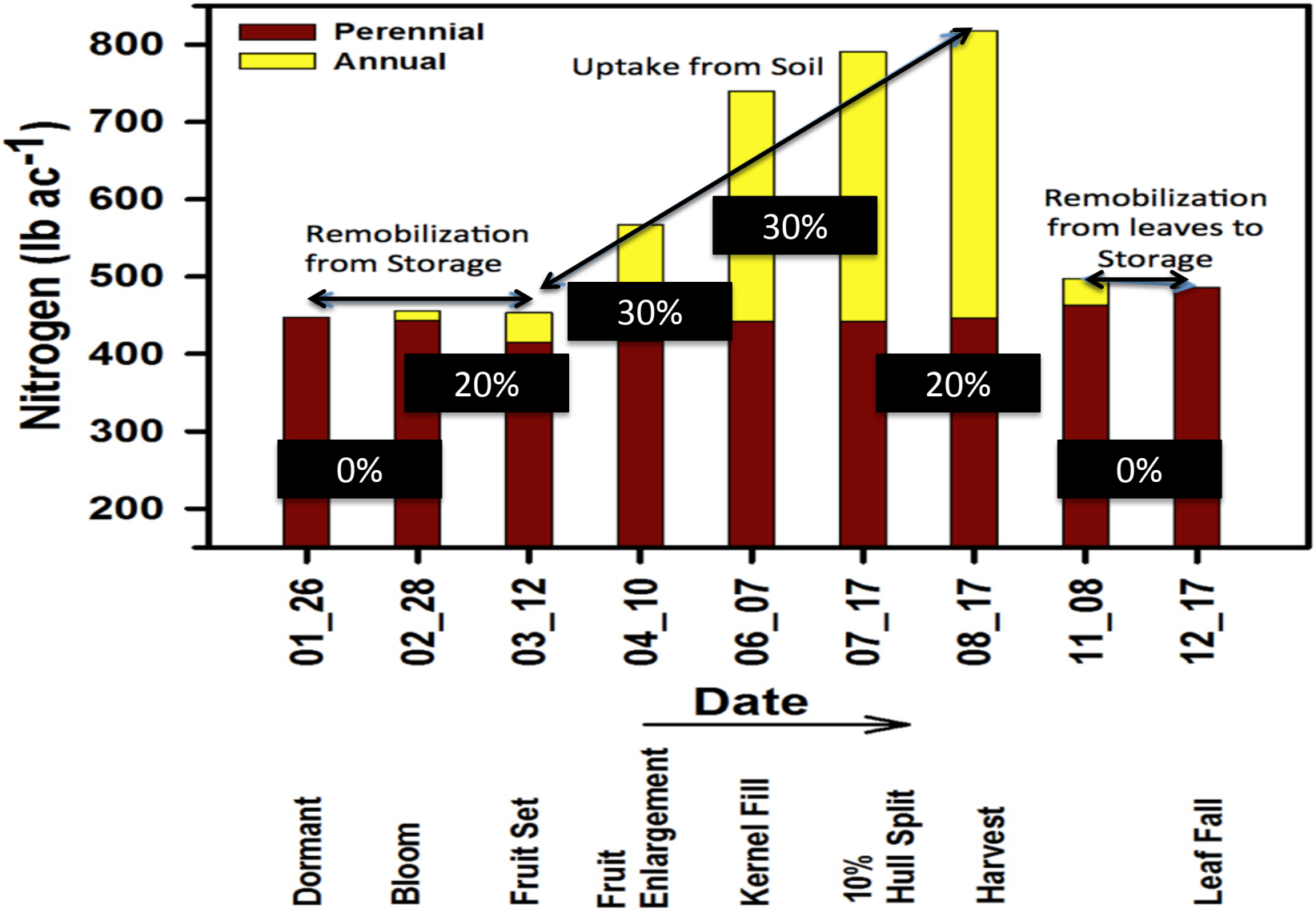
Right Rate and Timing: Almonds

- Applying excess N does not result in greater uptake by fruit, but does increase leaching potential
- There is less vegetative growth when yield is high, even when N is applied in excess.

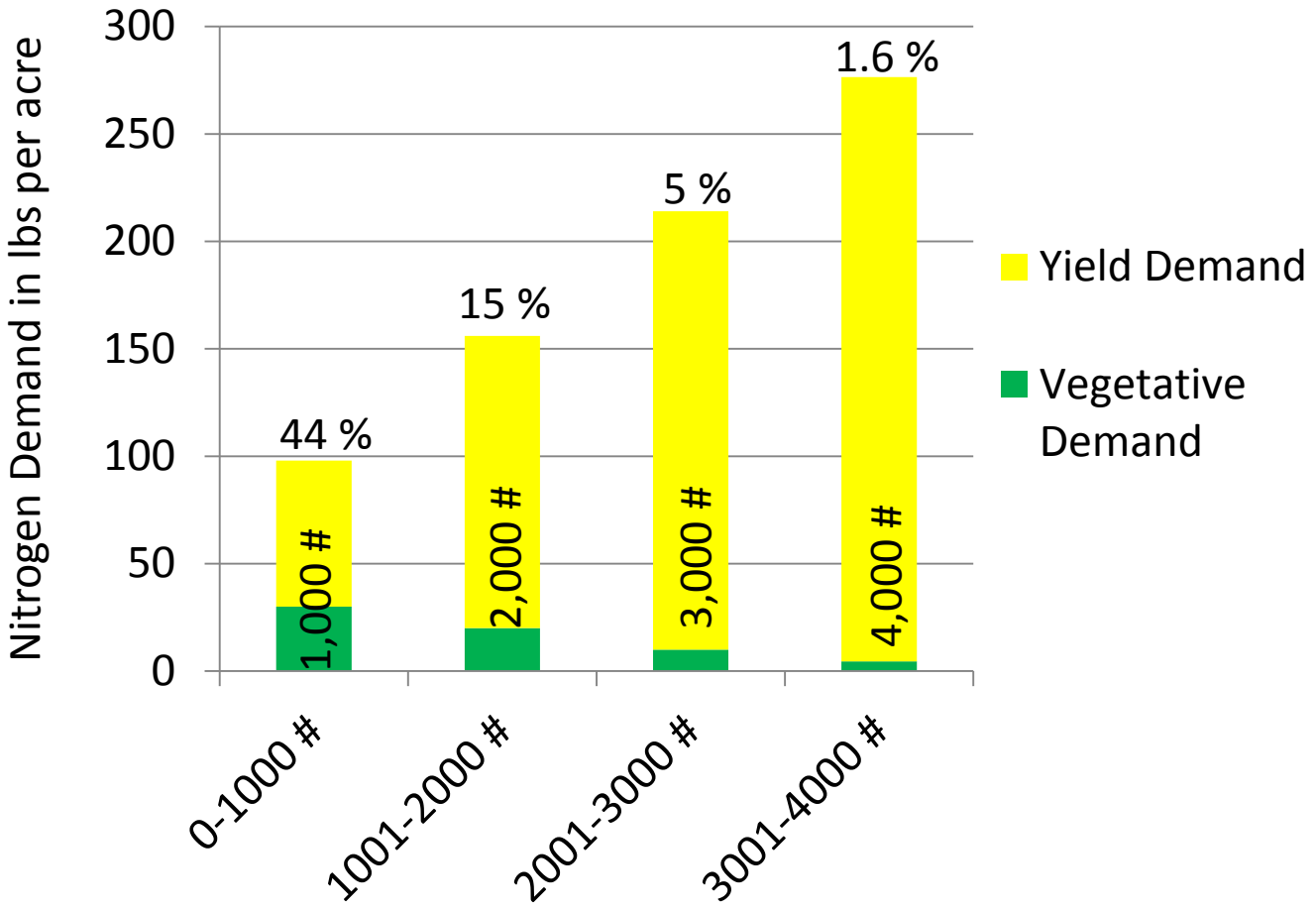


- Increasing N from 275 to 350 lbs did not increase fruit N removal at harvest.
- In plants receiving adequate N, 68 lbs of N is removed in 1000 lbs kernel yield.
- 80% of crop N is accumulated by 130 days after full bloom.

Right Rate and Timing: Almonds

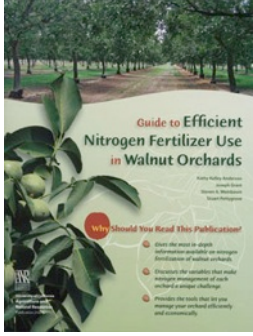


Right Rate: Yield vs. Vegetative Growth in Almonds



The proportion of the annual N budget that goes to vegetation declines as the yield increases above 2,000 lbs.

Right Rate: Walnuts



- 14-20 lbs N per 1000 (in-shell, including hull)

- UC-Davis, the Walnut Board of California, and FREP currently refining walnut data

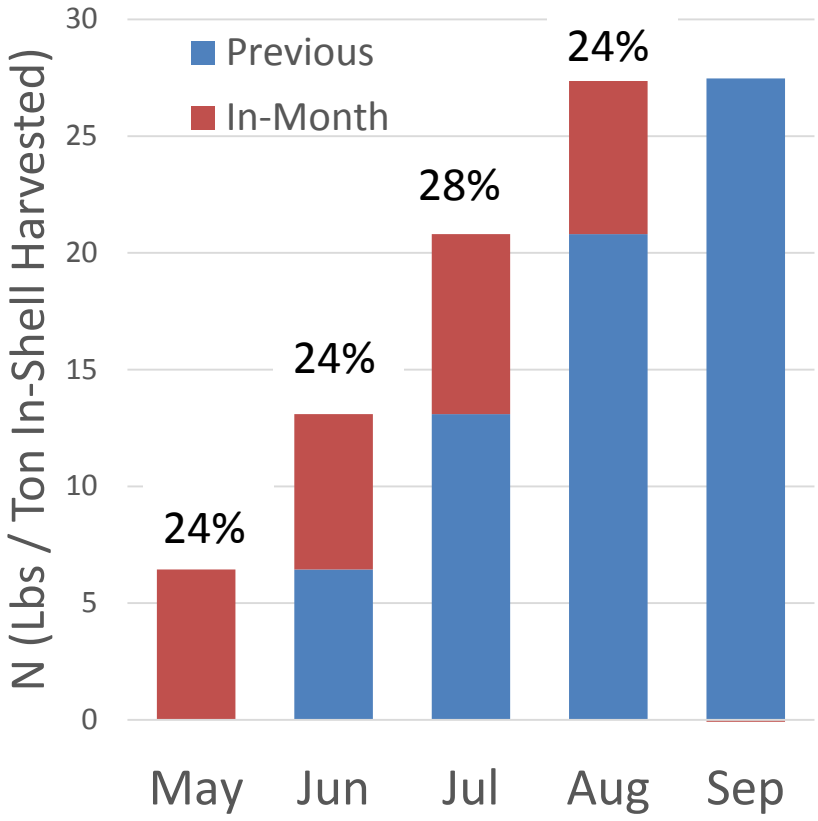
- Additional Resources:
  - Detailed instructions for Walnut N demand and budget by Kathy Kelley and Joe Grant http://ucanr.edu/datastoreFiles/391-755.pdf
  - A more in-depth version of the above worksheet is available for $10 here: http://anrcatalog.ucdavis.edu/Details.aspx?itemNo=21623

Right Rate: Walnuts

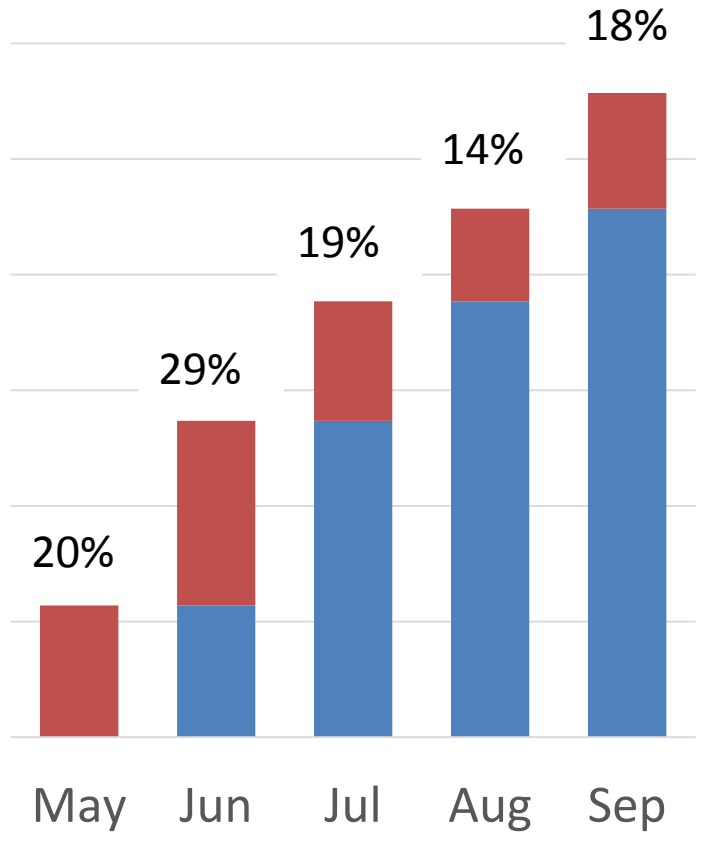
Walnuts: Monthly Nitrogen Accumulated in Fruit

(For every harvested ton. Lbs & Percent of Total)

Chandler (Fruit) - 2013



Tulare (Fruit) - 2013



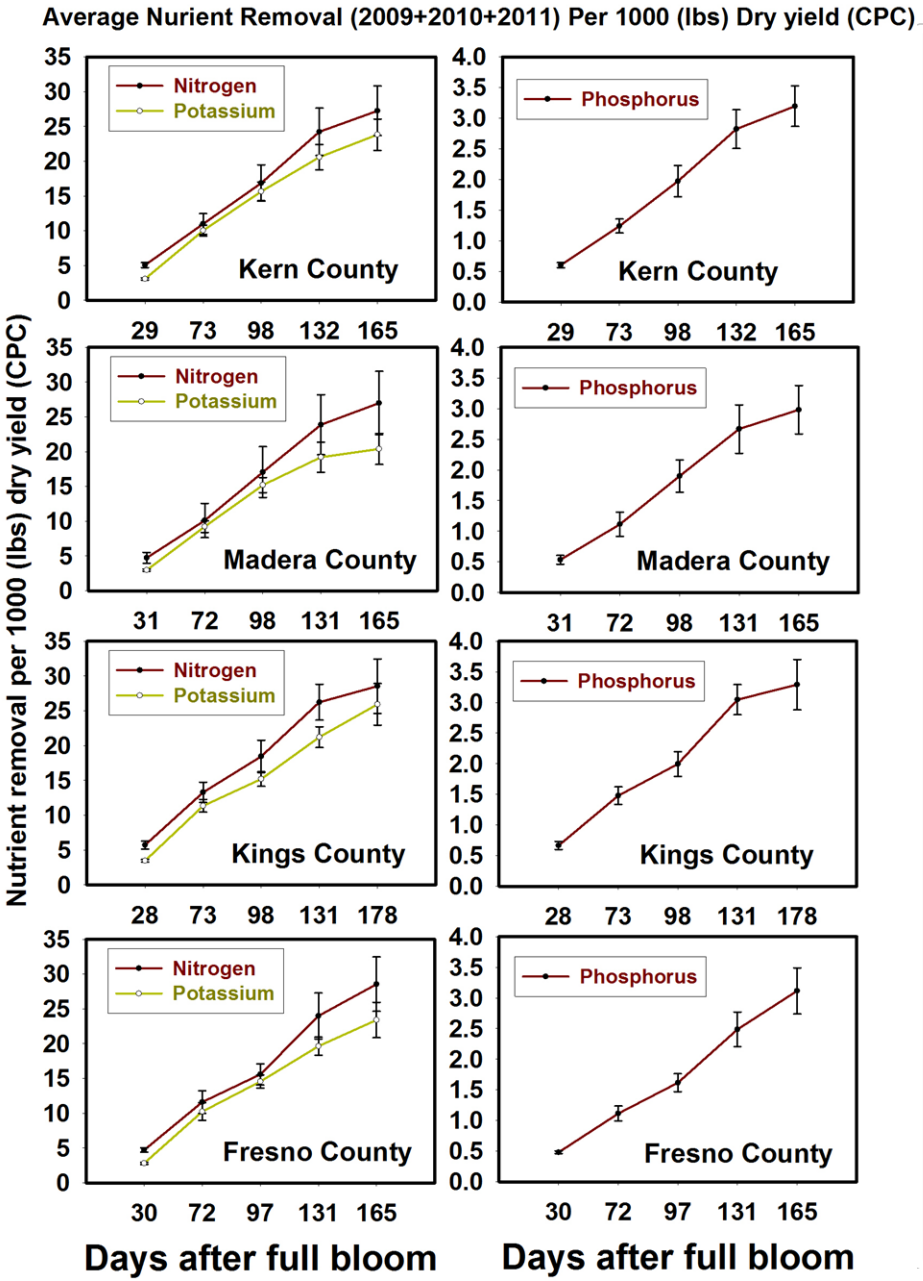
Right Rate: Walnuts

- N demand to replace abscised leaves and prunings – 8 lbs N/acre/year
- N storage in woody trees parts –
  15 lbs N/acre/year

- Recommendations for N in walnut can be found be running this online model

http://ucce.ucdavis.edu/rics/fnric2/walnutnmodel/html/walnut_n_model.html

Right Rate and Time: Pistachios



Nutrient removal per 1000 lbs dry CPC yield

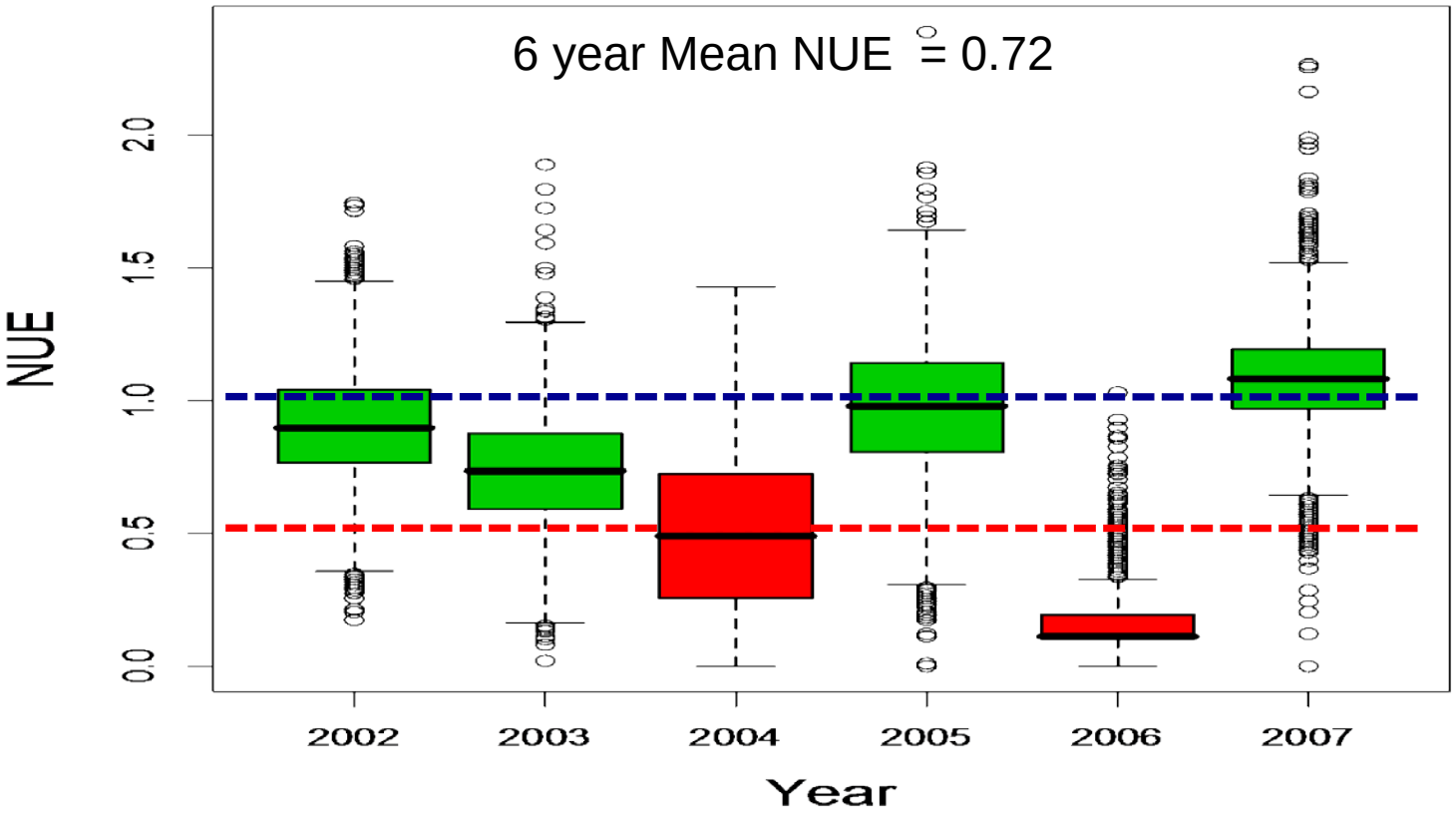
- Valuable for estimating demand or replacing nutrient export
- Provides insight into efficiencies
  - N removal 28 lbs per 1000
  - K removal 24 lbs per 1000
  - P removal 3 lbs per 1000
- 25 lb N and 22 lb K per acre, per year is required for tree growth (Rosecrance et al 1998)

(Brown and Siddiqui-unpublished)

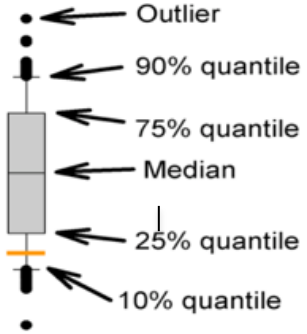
Improving N Use Efficiency

N Use Efficiency: Pistachios

Tree NUE = N removed in harvested fruit / applied N



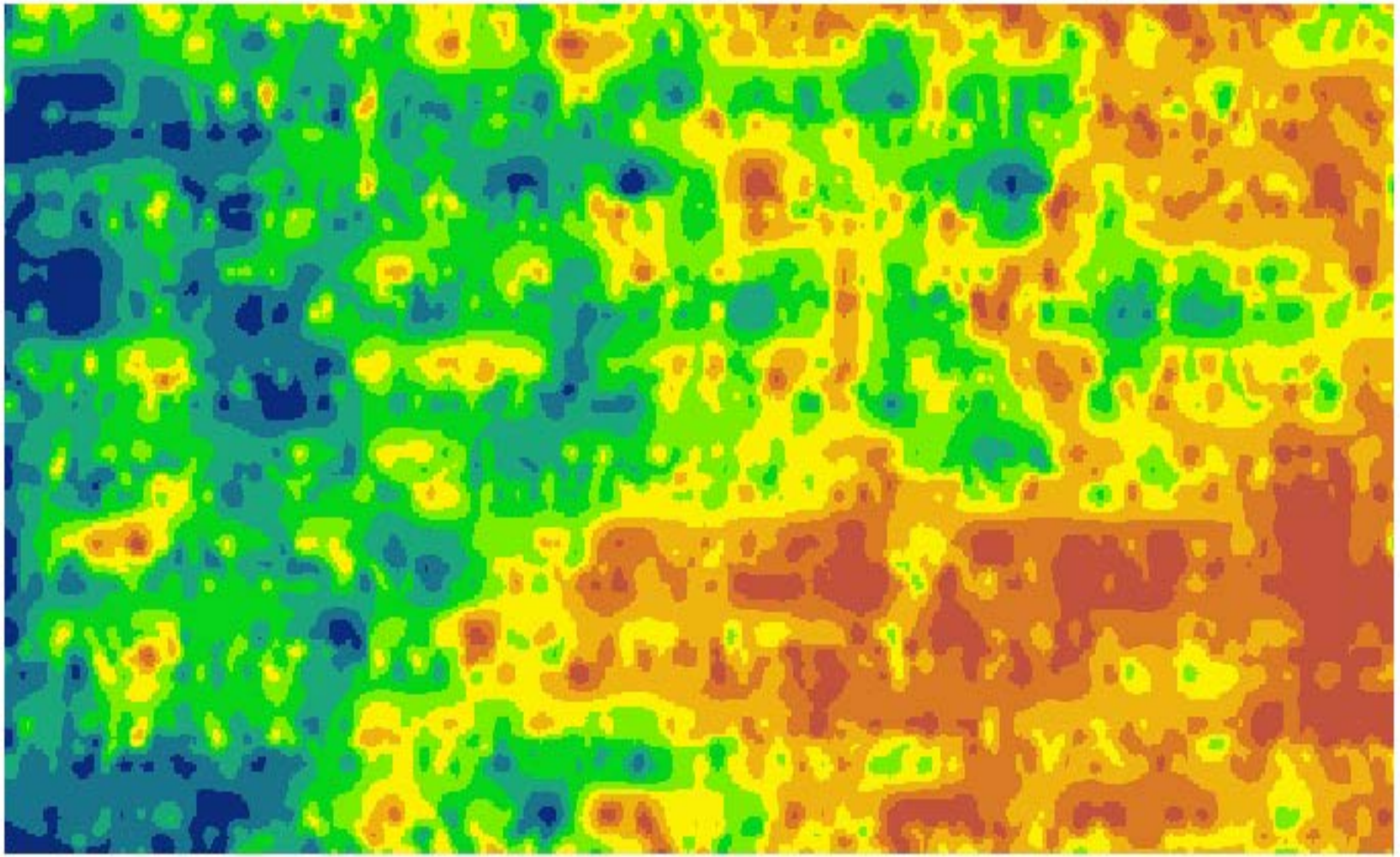
- 42,000 lbs N applied for 6 years to 40 acres
- 26,880 lbs N exported in yield
- $6{,}000_{est}$ lbs N pruning, leaves, and growth
- 9,120 lbs N 'lost' 38 lbs N/acre/year



- 24 yo Pistachio, 5 inch rainfall zone, no deep percolation.
- Silt loam, pH 6.7-7.0, OM 0.6%, 2 ppm NO_3N (100cm).
- Fertigated with five in-seasons split apps.
- 10 yr ave yield = 4,000 lb/acre= 112 lb N acre in exported fruit
- Mean N application 175 lb/acre.

Non-uniform Yield Within Field

Varying yields across 80 acres of Pistachio trees:



Managed as a single plot, large fields will always be non-uniform and less nutrient-efficient than smaller fields.

N Management Tools

Leaf Sampling:

- July/August leaf sampling is useful to monitor general performance or identify deficiencies but is inadequate as a management strategy because it:
  - Does not provide rate or timing information
  - Comes too late to adjust in-season fertilization.

- UCD has developed new Early Leaf Sampling (UCD-ESP for Almond and UCD-PPM for Pistachio) methods for Almond and Pistachio, and is in progress for Walnut
  - Early sampling is useful to determine if leaves have commenced the season with adequate N, and is a valuable supplement to yield based fertilizer management practices

- Several labs have adopted these methods
  - Ask your lab if they use the UCD-ESP or UCD-PPM program

Leaf Sampling:

- Collect leaves/leaflets from 18 -28 trees in one bag per management zone.
- Each tree sampled should be at least 30 yards apart
- In each tree collect leaves around canopy from 20+ exposed leaves/leaflets on non-fruiting spurs or shoots located 5-7 feet from the ground.
- Analyze leaf tissue for essential plant nutrients (N, P, K, S, Mg, Ca, B, Cu, Fe, Mn, Zn)
- For early leaf samples utilize UCD developed early sampling guidelines for interpretation.
- For July sampled leaves utilize standards provided in the Almond and Pistachio Production manuals.

Managing N in Almond, Pistachio and Walnut:

- Base preseason fertilizer plan on expected yield LESS N in irrigation and other inputs.
  - 1000 lbs almond kernel removes 68lb N
  - 1000 lbs pistachio (CPC yield) removes 28 lbs N
  - 1000 lbs in-shell walnuts removes 14-20 lbs N
  - Account for vegetative growth for each tree nut crop
- Conduct a leaf analysis following full leaf out.
- In April-May, review leaf analysis results and updated yield estimate, then adjust fertilization for remainder of season.

Online Tools:

- N Calculator developed by SureHarvest and the Almond Board of California available at

  www.sustainablealmondgrowing.org
- CDFA FREP website for all tree ntus

  Almond - http://apps.cdfa.ca.gov/frep/docs/Almonds.html

  Walnut - http://apps.cdfa.ca.gov/frep/docs/Walnut.html

  Pistachio - http://apps.cdfa.ca.gov/frep/docs/Pistachio.html
- UC Davis Fruits and Nuts website

http://fruitsandnuts.ucdavis.edu/Weather_Services/Nitrogen_Prediction_Models_for_Almond_and_Pistachio/

Conclusions: N Management in Tree Nuts

- Efficient N management is determined by the 4Rs
- Determine N demand for each individual crop
- Time to match demand – 80% in-season 20% post maturity if needed and trees are healthy
- Target placement where roots are active
- Account for all potential N sources including fertilizer, cover crops, compost, manure, and irrigation water

Every field, every year, is a unique decision

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